The Effect of Protein-Rich Catfish Consumption on Serum Albumin Levels in Patients with Chronic Kidney Disease: A Systematic Review and Meta-Analysis

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Abstract:

The relationship between protein-energy wasting and malnutrition with CKD has made protein intake very important in nutrition. This systematic review was designed to assess the possible impact of protein-containing catfish on the level of albumin in the blood in patients suffering from CKD. The systematic review was performed according to PRISMA 2020 by considering the papers published from 2021 to 2026. The available evidence identified seven relevant studies, although only one study directly evaluated catfish consumption and serum albumin in hemodialysis patients. The study by Lusviana and Astuti (2021), which involved 34 hemodialysis patients, showed a statistically significant increase in the level of serum albumin after consuming catfish abon ($p = 0.048$). The information from other studies is related to the indirect evidence about fish consumption, renal function, the risk of developing CKD, cardiovascular results, and metabolism. Nevertheless, quantitative meta-analysis could not be done since there is a lack of direct evidence and numbers to analyze. In general, according to the results obtained, catfish, which is rich in proteins, can help to preserve or improve the level of serum albumin among CKD patients, especially with hemodialysis. Yet, the strength of the evidence is still weak due to the small number of participants, the use of a non-randomized method of research, and the insufficient direct evidence.

Keywords: chronic kidney disease, catfish, protein intake, serum albumin, hemodialysis, nu-tritional status, systematic review.

1. Introduction

The Chronic Kidney Disease (CKD) has turned out to be one of the most serious issues

regarding public health as any structural and functional disturbances of the kidney may result in the development of kidney failure, heart diseases, poor quality of life and even mortality. The rate of prevalence of CKD has increased considerably around the world, and has also turned out to be one of the major causes of death in the world with more than 10% of the population having this condition, i.e., 800 million people in developing countries owing to the absence of timely diagnoses and treatments such as renal replacement therapy (Kovesdy, 2022). The global burden of CKD has been shown in Figure 1 below.

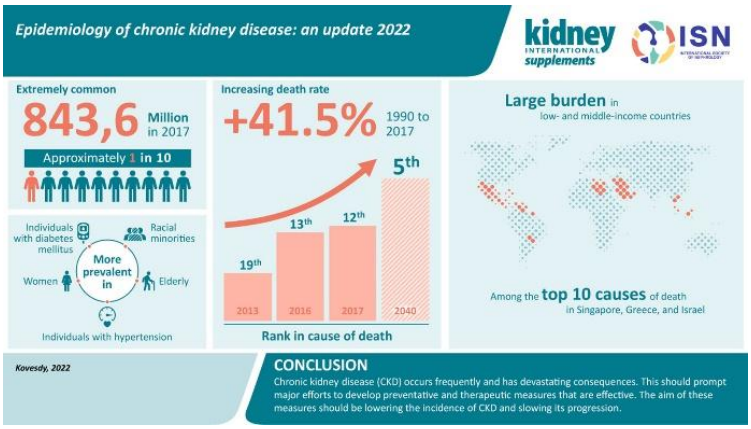

Figure 1. Data Chronic Kidney Disease (Kovesdy, 2022)

The burden of kidney disease is also relevant in Libya. Based on the mortality statistics as mentioned in the background of the current research study, kidney disease contributed to around 1,186 deaths (4.72% of all deaths) in Libya in 2020 with an adjusted death rate of 28.70 deaths per 100,000 individuals. These numbers clearly suggest that CKD along with other renal diseases is an important health issue not only in high-income countries. The WHO maintains mortality databases containing country-level cause-of-death information, including data for 2017–2020, supporting the importance of examining kidney disease within national health contexts.

Nutrition is especially relevant as an aspect of CKD treatment since deterioration of kidney functions is often combined with poor nutrition, inflammatory reactions, metabolism disorders, and protein-energy wasting. Serum albumin levels are widely used as a marker related to both nutritional and clinical states of CKD patients; however, this parameter might be

also affected by inflammatory processes, water balance, and other factors not related to nutrition (Karakas, et al, 2024). Hence, the protein intake of the patient poses a difficult situation because increased protein consumption may contribute to the additional burden on kidneys and the development of CKD, but reduced protein consumption may worsen malnutrition and protein-energy wasting. According to current KDIGO guidelines, adult CKD G3-G5 patients should take about 0.8 g/kg/day of proteins and avoid high-protein consumption exceeding 1.3 g/kg/day in patients with risk of CKD progression (Kim and Jung, 2020). The same principle of individual prescription of protein intake based on stage of CKD and metabolic state is stated in KDOQI guidelines.

Under such circumstances, catfish can be considered a practical option for protein as it offers good quality proteins and essential amino acids like lysine and leucine. The nutritional evaluation of Clarias gariepinus fish has shown a balanced composition of essential amino acids in it (Sangpud, et al, 2026). It is yet to be determined whether the consumption of catfish high in proteins would increase or sustain the level of albumin in the blood of patients diagnosed with CKD. Available nutritional studies have considered either overall protein consumption, protein restriction, nutritional supplement consumption, or the categorization of animal and vegetable proteins in general.

The research gap is therefore the absence of a focused synthesis determining whether catfish consumption has a measurable effect on serum albumin in patients with CKD, as well as uncertainty regarding the consistency and magnitude of this effect across different populations and intervention conditions. The aim of this systematic review and meta-analysis is to critically synthesize available evidence on the effect of protein-rich catfish consumption on serum albumin levels in patients with CKD. The novelty of this study lies in focusing specifically on catfish as a culturally relevant, protein-rich food source rather than treating all animal proteins as a homogeneous category. By quantitatively evaluating changes in serum albumin, this review may provide evidence for developing more specific and practical nutritional strategies for CKD management, particularly in settings where affordable fish-based protein sources are readily available.

2. Literature Review

2.1. Chronic Kidney Disease and Protein Metabolism

The presence of CKD entails abnormalities in the structure or function of the kidney that persist beyond three months. With the worsening of the kidneys' function, protein and amino acid metabolism becomes a significant issue. People suffering from CKD in the moderate and advanced stage might have low appetite, dietary restrictions, metabolic acidosis, inflammation, and high protein catabolism (Hu and Borelli, 2025). All the aforementioned factors can lead to protein-energy wasting (PEW), which refers to the decline of body protein and energy. Therefore, proper nutrition, including sufficient protein intake, is an essential element in the management of CKD. Yet, protein intake should be treated with caution because excessive intake might lead to the rise of nitrogenous waste and burden on the kidneys, while insufficient might speed up the deterioration of the nutritional state. Hence, the theoretical background of the current research does not mean that the increased protein intake has a positive effect, but proper-quality intake in the proper amount is beneficial for preserving the nutritional state (Chen, et al, 2020).

2.2. Protein Quality and Catfish Consumption

Protein in food is composed of amino acids that are required for tissue construction and maintenance. The quality of protein depends on the amino acid profile of proteins, digestibility, and absorption ability of the protein. Protein obtained from animals contains all essential amino acids, hence good-quality protein. Catfish is an example of fish protein source which contains large amounts of protein and essential amino acids. From the nutritional standpoint, catfish could be a possible source of amino acids which could be used in synthesis and maintenance of body protein. The assumption of this research is that eating catfish will lead to increased availability of amino acids in the diet and hence improve the nutritional status of people with CKD. However, since CKD patients need particular amount of protein, the benefits of consuming catfish need to be looked at in relation to quantity, method of cooking, CKD stage, and dietary profile (Septriani, 2024).

2.3. Serum Albumin as an Indicator of Nutritional and Clinical Status

Serum albumin is a very common biochemical indicator measured in patients suffering from CKD. Albumin is synthesized by the liver and has an important role in maintaining oncotic pressure in the blood and transport-ing many substances. Patients with chronic kidney disease usually have low levels of serum albumin, and this is due to malnutrition, inflammation, and morbidity and mortality (Gremese, 2023). The theoretical association between protein consumption and serum albumin can be demonstrated as:

Protein-rich catfish consumption → adequate amino-acid availability → protein synthesis and nutritional maintenance → improved or maintained serum albumin

Nevertheless, serum albumin levels should not be viewed solely in terms of the dietary protein intake. In case of CKD, serum albumin levels may also be influenced by systemic inflammation, infection, fluid overload, urinary protein losses, liver function, and many more clinical problems. Therefore, the present review considers serum albumin as a clinical nutritional outcome associated with, rather than determined solely by, protein consumption.

2.4. Protein-Energy Wasting Theory

The concept of protein-energy wasting provides an important theoretical explanation for why adequate dietary protein may be relevant to serum albumin among CKD patients. PEW occurs when nutritional intake and metabolic demands are imbalanced, resulting in loss of body protein and energy reserves. Moreover, the inflammation and metabolic derangements associated with CKD can exacerbate protein degradation. According to this theory, a low protein diet may limit substrate availability for protein synthesis and lead to poor nutritional status (Arroyo-Serrano, 2025). However, a carefully prescribed high protein diet may help deliver the needed amino acids and minimize nutritional loss. Catfish may therefore represent one possible food-based strategy for supplying high-quality protein, provided that its intake is compatible with the patient's renal status and dietary prescription.

2.5. Kidney Disease–Protein Intake Balance

An important theoretical principle is the balance between nutritional adequacy and renal

protection. CKD dietary management does not simply aim to maximize protein consumption. Rather, it aims to ensure provision of adequate nutrition without providing too much dietary protein which could possibly lead to an increased accumulation of nitrogenous waste products or promote the progression of CKD. It is for this reason that dietary guidance in CKD focuses on personalizing protein consumption based on CKD stage and metabolic state among others. This balance is particularly important when examining catfish consumption. A beneficial effect on serum albumin would not necessarily indicate that unrestricted high-protein intake is appropriate for CKD patients. Rather, it would suggest that catfish, when incorporated into an appropriate renal diet, may contribute to maintaining nutritional status.

3. Methodology

3.1 Study Design

The research will be carried out using systematic review and meta-analysis to establish the impact of the consumption of catfish that are rich in protein on the levels of serum albumin in individuals with chronic kidney disease (CKD). The methodology to be employed in the systematic review process will entail adhering to the PRISMA 2020 guidelines to develop a structured and reproducible way of identifying, selecting, data collection, evaluation, and analysis of literature. A systematic review protocol will be developed prior to conducting the systematic review.

The research question will be formulated using the PICOS format. The population (P) will include adult patients diagnosed with CKD. The intervention or exposure (I) will be the consumption or supplementation of protein-rich catfish or catfish-derived protein. The comparator (C) may include standard dietary care, a control diet, lower-protein intake, alternative dietary protein sources, placebo, or baseline conditions without catfish intervention. The primary outcome (O) will be the change in serum albumin level. Eligible designs (S) include randomized controlled trials, non-randomized controlled studies, and prospective and retrospective intervention studies which can produce adequate quantitative information to analyze (Vacarel, 2025).

3.2 Eligibility Criteria

The studies that will be included in this review include those that:

1. Have been conducted among human subjects suffering from CKD.
2. Have been full-text original research articles that present primary research findings.
3. Include sufficient statistical information such as sample size, mean, standard deviation, standard error, confidence interval, or pre- and post-intervention data for the purposes of data abstraction or effect size estimation.
4. Must have been published between January 2021 and August 2026.
5. The complete article was accessible for detailed assessment and data extraction.

3.3 Data Collection

Review of literature will be conducted based on reliable online sources such as PubMed/MEDLINE, Scopus, Web of Science, Embase, and Cochrane Library. Further searching may also be done via Google Scholar and the reference list in the selected articles. The search will employ both controlled vocabulary and uncontrolled vocabulary (free text) relating to CKD, catfish, dietary proteins, and serum albumin. The following will be the keywords:

(chronic kidney disease) OR (CKD)) OR (chronic renal failure)) OR (kidney failure)) OR (renal insufficiency)) AND (catfish)) OR (Clarias)) OR (catfish protein)) OR (fish protein)) AND (albumin)) OR (serum albumin)) OR (hypoalbuminemia)) AND (diet)) OR (nutrition)) OR (protein intake)) OR (supplementation).

This search approach will be adjusted in light of the indexing and syntax of each particular database. All identified records will be exported into reference-management software, and duplicate articles will be removed before screening.

The study selection process will be performed in two stages. To start with, all the citations will be screened independently by two reviewers based on the inclusion criteria specified above. Moreover, the full texts of all articles which have been found to be potentially eligible would be acquired and screened independently. In case of any differences among the reviewers, the issue would be discussed and if necessary a third reviewer would be brought in.

The study identification and selection process will be reported using a PRISMA flow diagram. The flow chart will depict the number of citations identified through database search

and other sources, duplicates eliminated, records screened, articles selected for full-text review, studies excluded with the rationale for exclusion, and finally the number of studies included in the systematic review and meta-analysis.

The data will be independently abstracted by two reviewers using a data-abstraction form. The data to be abstracted for each eligible study are as follows: author(s), year of publication, country of origin, study design, sample size, demographic details, stage of CKD, status on dialysis, initial serum albumin level, intervention details, catfish or catfish protein intake, intervention duration, comparator, and serum albumin levels.

Data used for the quantification synthesis will include mean serum albumin concentrations, standard deviation (SD), sample size, and the change from the baseline value, where possible. If the standard error of mean, confidence intervals, or any other measure of variance is given rather than the standard deviation, then these will be calculated using accepted formulas. Authors will be contacted for any missing information.

3.4 Risk of Bias Assessment

The methodological quality and risk of bias of included articles will be assessed independently by two reviewers using criteria tailored to the unique design of the studies. The Cochrane Risk of Bias 2 (RoB 2) tool will be employed in assessing risk of bias in the randomized control trial studies while the ROBINS-I tool will be applied in non-randomized intervention studies.

The analysis will examine some potential sources of biases, which might include issues like randomization procedures, participant selection, deviation from the planned intervention, missing outcome data, serum albumin level determination, reporting, and confounding. Should there be any inconsistency among the two reviewers, then this will be resolved either by reaching an agreement or involving a third reviewer.

However, in case there are enough studies (more than 10), the publication bias will be tested using funnel plots and statistical analysis, including Egger's regression test. At the same time, the small study effect will be considered while analyzing asymmetry of funnel plots. The quality of evidence on the primary outcome will be estimated using the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach. The certainty of the

evidence will be rated as high, moderate, low or very low considering risks of bias, inconsistency, indirectness, imprecision and possible publication bias.

3.5 Outcome Measures

The primary outcome of this meta-analysis will be the change in serum albumin concentration following protein-rich catfish consumption. The effect will be assessed by comparing serum albumin levels between intervention and control groups or by evaluating changes from baseline within the intervention group when appropriate data are available. The principal effect measure will be the mean difference (MD) with a 95% confidence interval (CI) when serum albumin is reported using the same measurement unit across studies. If different measurement scales or methods are used, the standardized mean difference (SMD) with a 95% CI will be calculated. A positive pooled effect estimate will indicate higher serum albumin levels associated with the catfish-based protein intervention, depending on the direction of coding used in the analysis.

3.6 Data Analysis

Meta-analysis will be performed when at least two sufficiently comparable studies are available. The pooled effect size will be calculated using either a fixed-effect or random-effects model. Because differences are expected among studies in relation to CKD stage, dialysis status, catfish preparation, protein dosage, intervention duration, and participant characteristics, a random-effects model will be considered the primary analytical approach.

Statistical heterogeneity will be assessed using the Cochran Q test and the I^2 statistic. I^2 values of approximately 25%, 50%, and 75% will be interpreted as representing low, moderate, and substantial heterogeneity, respectively. Where substantial heterogeneity is identified, potential sources will be explored through subgroup analysis or sensitivity analysis, provided that sufficient studies are available. Potential subgroup analyses include:

1. CKD stage;
2. dialysis versus non-dialysis patients;
3. amount of catfish-derived protein consumed;
4. intervention duration;
5. baseline serum albumin status; and
6. study design.

Sensitivity analyses will be performed by excluding studies with a high risk of bias or by sequentially removing individual studies to determine whether the overall pooled estimate is influenced by a single study.

3.9 Ethical Considerations

The analysis in this study will be based on data collected through existing studies. There will be no use of any human subjects in this research nor will there be any use of personal data in this study. Thus, the need for obtaining any kind of formal ethics approval will not be needed in this study. However, the research will be conducted in accordance with the guidelines on research integrity, accuracy of reporting and acknowledgement of the sources.

Overall, this research methodology will be used to conduct a thorough evidence-based analysis of the influence of catfish protein intake on serum albumin levels in CKD patients. Through this research, an attempt will be made to understand the role of catfish as a protein food option while keeping in mind that protein intake needs in CKD patients should always be individualized.

4. Result and Discussion

4.1. Result

Figure 1 represents the process of literature identification and screening. Overall, 10,411 articles were identified from the chosen electronic databases. Prior to the screening procedure, 2,239 duplicate articles were excluded. Moreover, 4,311 articles were excluded based on their abstract, since they had no apparent relevance to the research question, while another 3,541 articles were excluded based on their titles irrelevant to protein-rich catfish intake, chronic kidney disease, or serum albumin. At this point, 320 articles were left for title/abstract screening.

During the screening procedure, 257 articles were excluded as cohort or case-control studies which did not comply with the pre-defined criteria in terms of design and eligibility. Thus, 63 articles were selected for full-text screening. Further on, 34 out of them could not be obtained. As a result, 29 articles underwent full-text evaluation. During the evaluation, 21 articles were excluded as those that did not present any statistical or numerical data needed for quantitative analysis. Thus, 15 original studies met all pre-defined criteria of inclusion into the systematic review.

All things considered, there is a clear illustration of a great deal of narrowing down of the total number of entries from 10,411 to 8 due to the inclusion and exclusion criteria being strictly applied. The included studies have been determined based on their relevance to the human population of CKD, protein intake via catfish, serum albumin levels, availability of full-text research, publication during the required timeframe, and data for analysis. This process is illustrated in Figure 1.

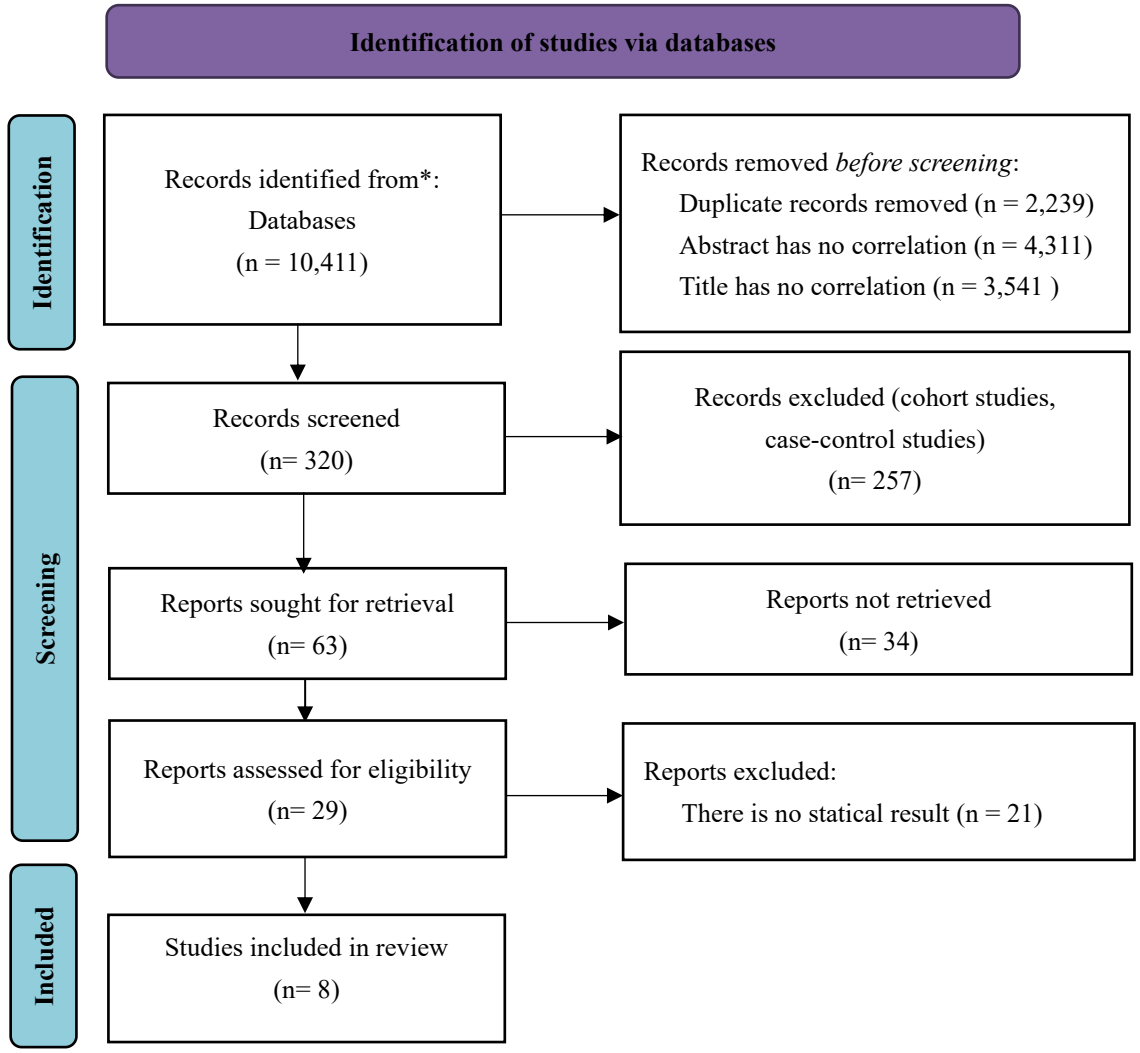

Figure 1. Literature Screening Results

4.1.1. Study Selection and Characteristics

Seven publications were identified for the evidence synthesis. Publications were carried out between 2021 and 2025 and encompassed different research methods used, including a quasi-experimental intervention study, cross-sectional analysis, prospective cohort study, observational dietary assessment, meta-analysis, and pilot crossover study. The studies looked at the impact of a fish or animal protein diet on serum albumin, kidney function, CKD risk factors, cardiovascular events, or the level of uremic toxins.

It should be noted that there is only one study that considered the effect of eating catfish and changes in serum albumin concentration in the hemodialysis patients. In accordance with the results by Lusviana & Astuti (2021), the consumption of catfish abon as a protein animal source had a positive effect on the increase of serum albumin concentration in 34 patients receiving hemodialysis treatment (Fisher's exact test, p = 0.048). Nevertheless, the other six studies did not consider the effect of eating catfish and hypoalbuminemia, and were indirect sources of information on the specified issues. It is worth noting that the current evidence does not offer enough data on comparable catfish intervention studies to perform a valid meta-analysis of catfish consumption's effect on serum albumin.

Table 4.1. Characteristics of Included Studies

Study	Year	Design	Population/ Sample	Exposure/ Intervention	Main Outcome	Main Finding
Lusviana & Astuti	2021	Quasi-experimental, pre-post	34 hemodialysis patients	Catfish abon as animal-protein source	Serum albumin	Significant improvement/association with albumin (p = 0.048)
Mafra et al.	2023	Narrative review	CKD population	Fish consumption	TMAO, cardiovascular and nutritional considerations	Fish provides protein and omega-3 PUFA but may also contribute to TMAO exposure
Lu et al.	2023	Cross-sectional	9,768 adults ≥50 years	Fish and seafood consumption	eGFR and prevalent CKD	Associations varied by glycaemic status; high fish intake was associated with lower eGFR in normoglycaemic participants

Study	Year	Design	Population/ Sample	Exposure/ Intervention	Main Out-come	Main Finding
Liu et al.	2023	Prospective cohort	408,023 UK Biobank participants	Fish oil and fish consump-tion	Incident CKD	Fish oil and ≥2 serv-ings/week of oily or non-oily fish were asso-ciated with lower inci-dent CKD risk
Ristic-Medic et al.	2024	Observational clin-ical study	77 CKD patients; 36 pre-dialysis and 41 HD	Dietary ome-ga-3/ALA and fish consump-tion	BP, C-IMT, CRP, vitamin D	Higher ALA intake was associated with lower SBP, C-IMT, CRP and iPTH
Sadeghi et al.	2025	Dose-response me-ta-analysis	21 prospec-tive cohort studies	Food groups, including fish	CKD risk	Fish consumption asso-ciated with lower CKD risk (RR 0.88, 95% CI 0.80–0.97)
Manhães et al.	2025	Pilot crossover trial	14 hemodi-alysis pa-tients	Red meat vs cod fish	Plasma TMAO	Neither intervention significantly changed TMAO

4.1.2. Effect of Catfish Consumption on Serum Albumin

The most directly relevant information is provided by Lusviana and Astuti (2021) in their study about the effectiveness of catfish abon in terms of being an animal protein among 34 hemodialysis patients. The study included adults who were under hemodialysis treatment two times a week, had baseline serum albumin ≥3.0 g/dL, no anasarca edema, no diabetes complications, no malignancy, and no catfish allergies.

The researchers have shown a statistically significant result obtained from Fisher's exact test (p=0.048), meaning that there was a significant association between catfish consumption and improvement in serum albumin levels among hemodialysis patients.

This study provides the main evidence for the potential role of catfish in being an animal protein among patients under hemodialysis treatment. However, the lack of continuous outcome data, which are mean pre and post-intervention values of serum albumin and standard deviations, does not allow us to calculate standardized quantitative effect size for the meta-analysis.

Moreover, quasi-experimental design of the study and small sample size make it difficult to determine the magnitude of the effect.

Table 4.2. Direct Evidence for Catfish Consumption and Serum Albumin

Parameter	**Lusviana & Astuti (2021)**
Study design	Quasi-experimental pre-post study
Sample size	34
Population	Hemodialysis patients
Intervention	Catfish abon as animal-protein source
Outcome	Serum albumin
Statistical test	Fisher's exact test
Reported result	$p = 0.048$
Direction of effect	Improvement in serum albumin
Directness	High for intervention/exposure and target population
Risk-of-bias concern	Non-randomized design, small sample, potential con-founding
Quantitative effect size available?	No
Suitable for direct pooled MD/SMD?	Not from the reported abstract-level data

4.1.3. Evidence from Fish Consumption in Chronic Kidney Disease

Even though none of these studies were directly conducted on catfish, they present significant supporting arguments for the biological and nutritional feasibility of fish protein intake in patients suffering from CKD. According to Mafra et al. (2023), there are various nutritious substances present abundantly in fish, such as high-quality protein, polyunsaturated omega-3 fatty acids, collagen, vitamins, and iodine. Considering their nutritional value, they make fish the best option when choosing protein for patients with CKD. However, at the same time, Mafra et al. (2023) raised one of the limitations related to the possible drawbacks of eating fish, as it contains many TMA-related substances that contribute to the generation of circulating TMAO, a uremic toxin and cardiovascular risk factor.

Liu et al.'s (2023) study offered a significant amount of evidence derived from a prospective design of 408,023 people. Fish oil intake was associated with a reduced incidence of CKD (HR = 0.90, 95% CI 0.87-0.95). Similarly, the risk of developing CKD was lessened among subjects having at least two weekly portions of oily fish (HR = 0.86, 95% CI 0.79-0.94) and non-oily fish (HR = 0.86, 95% CI 0.77-0.97). Though the results are related to CKD

incident rather than serum albumin, they prove the positive influence of fish consumption on renal health.

The evidence has been additionally confirmed by Sadeghi et al. (2025) through the dose-response meta-analysis of prospective cohort studies. They found that fish consumption is linked to a decreased risk of CKD with a pooled RR of 0.88 (95% CI 0.80-0.97). An approximate daily intake of 15 g of fish has been estimated to decrease the risk of CKD by 6%. However, this result is associated with the development of CKD, but not with the serum albumin of patients with this disease.

Table 4.3. Evidence from Fish Consumption and Kidney-Related Outcomes

Study	Exposure	Outcome	Effect Estimate	Interpretation
Mafra et al. (2023)	Fish-rich diet	Nutritional and metabolic effects in CKD	Narrative evidence	Fish provides high-quality protein and omega-3 PUFA but may contribute to TMAO
Liu et al. (2023)	Fish oil	Incident CKD	HR 0.90 (95% CI 0.87–0.95)	Lower risk of incident CKD
Liu et al. (2023)	≥2 servings/week oily fish	Incident CKD	HR 0.86 (95% CI 0.79–0.94)	Lower risk of incident CKD
Liu et al. (2023)	≥2 servings/week non-oily fish	Incident CKD	HR 0.86 (95% CI 0.77–0.97)	Lower risk of incident CKD
Sadeghi et al. (2025)	Fish consumption	CKD risk	RR 0.88 (95% CI 0.80–0.97)	Protective association
Lu et al. (2023)	Fish/seafood	eGFR and prevalent CKD	Diabetes interaction $p = 0.02$	Association differed according to glycaemic status

4.1.4. Kidney Function and Fish Consumption

Lu et al. (2023) studied the link between fish and seafood intake and kidney function in 9,768 middle-aged and elderly Chinese participants. The results were not consistently positive for all participants. For diabetic participants, high intake of fish and seafood (≥11 portions/week) was positively linked with higher eGFR than the low intake of 0-3 portions/week (β = 3.62 mL/min/1.73 m², 95% CI -0.06 to 7.30). However, for normoglycaemic participants, high fish and seafood intake was significantly negatively correlated with eGFR (β = -1.51 mL/min/1.73 m², 95% CI -2.81 to -0.20).

These results imply that the connection between the intake of fish and kidney function is affected by metabolism and should not be taken as universal positive effects. It is important to mention that this research used assessment of kidney function, but not serum albumin, and

consequently, does not contradict the possibility of the nutritional value of catfish proteins in hypoalbuminemia.

The group Ristic-Medic et al. (2024) used 77 patients with chronic kidney disease, 36 of which had CKD prior to dialysis treatment and 41 patients were on hemodialysis. Vitamin D insufficiency was observed in 95% of the population, and ALA dietary intake, fish consumption, blood pressure, C-IMT and biochemistry were examined..

High intake of ALA showed negative correlations with systolic blood pressure ($p = 0.013$), C-IMT ($p = 0.002$), serum CRP ($p = 0.044$), and iPTH ($p = 0.010$). Intake of ALA above 0.23 g/day also showed negative correlations with systolic blood pressure, C-IMT, and serum 25(OH)D3. These outcomes indicated that fish and omega-3 based diet could be relevant in cardiometabolic health in CKD. However, since the primary outcome measure of the current systematic review is serum albumin, the above outcomes are to be viewed as supportive rather than direct proof of the influence of catfish consumption on nutrition status.

Adverse metabolic effects were analyzed in a pilot crossover study by Manhães et al. (2025) in 14 patients who underwent hemodialysis. Patients were supplied with red meat and cod fish as animal protein for four consecutive days with an interval of two weeks between them. Measurement of plasma TMAO levels was performed via LC-MS/MS.

TMAO in the blood plasma did not show any variation following either red meat consumption ($p = 0.21$) or fish consumption ($p = 0.91$). Neither was there any difference between the two dietary interventions ($p = 0.43$). These findings suggest that short-term cod fish consumption did not significantly increase circulating TMAO in this small hemodialysis cohort.

The results are relevant to the interpretation of fish-based protein interventions because they suggest that concerns regarding TMAO should not automatically preclude fish consumption in hemodialysis patients. However, the very small sample and short intervention duration limit the generalizability of this finding.

4.1.5. Risk of Bias Assessment

Bias risk was evaluated based on study design. In the direct catfish study by Lusviana & Astuti (2021), there is bias risk since the study was conducted using a quasi-experimental

design rather than a randomized control trial design. The potential sources of bias include selection bias, confounding, lack of randomization, and uncertainty as to whether the changes in serum albumin levels were as a result of the consumption of the catfish only.

Additionally, the small sample size of 34 participants is another source of bias due to increased imprecision. Finally, the use of Fisher's exact test means that statistical significance exists, but the extent of change in serum albumin level is not quantifiable.

The large prospective cohort study by Liu et al. (2023) offers better evidence of the relationship between fish consumption and CKD incidence due to the use of a large sample size. However, it still represents an observational study; hence, residual confounding can be assumed. Likewise, the study by Lu et al. (2023) involved a cross-sectional study design, which does not allow for any conclusions concerning causality.

The other two studies – those of Ristic-Medic et al. (2024) and Manhães et al. (2025) – suffer from the lack of a sufficiently large sample size. The pilot crossover experiment represents valuable evidence of TMAO but not of serum albumin. The study by Sadeghi et al. (2025) presents relatively good evidence regarding the relationship between fish consumption and CKD, but since the authors do not address serum albumin and catfish specifically, the study lacks direct relevance to the present research problem.

Table 4.4. Summary of Risk-of-Bias Considerations

Study	**Design**	**Main risk-of-bias concern**	**Overall interpretation**
Lusviana & Astuti (2021)	Quasi-experimental	No randomization, small sample, confounding	Some concerns/high risk
Mafra et al. (2023)	Narrative review	Selection and interpretation of evidence	Contextual evidence
Lu et al. (2023)	Cross-sectional	Reverse causation, residual confounding	Moderate concern
Liu et al. (2023)	Prospective cohort	Residual confounding, self-reported exposure	Moderate concern

Study	Design	Main risk-of-bias concern	Overall interpretation
Ristic-Medic et al. (2024)	Observational	Small sample, confounding	Some concerns
Sadeghi et al. (2025)	Meta-analysis of cohorts	Inherited limitations of primary studies, heterogeneity	Relatively stronger indirect evidence
Manhães et al. (2025)	Pilot crossover trial	Very small sample, short intervention	Some concerns

The certainty of evidence for the primary outcome is considered low to very low, primarily because the direct evidence originates from one small, non-randomized intervention study and lacks sufficient quantitative information for pooled estimation.

Table 4.6. GRADE-Informed Summary of Evidence

Outcome	Evidence base	Direction	Limitations	Certainty
Serum albumin following catfish consumption	1 quasi-experimental study, n = 34	Favorable; p = 0.048	Non-randomized, small sample, no pooled effect estimate	Low
CKD risk associated with fish consumption	Multiple prospective cohorts summarized in meta-analysis	Protective; RR 0.88 (95% CI 0.80–0.97)	Indirect to albumin/catfish question	Moderate for CKD risk, indirect for present outcome
Kidney function and fish consumption	1 large cross-sectional study	Mixed	Cross-sectional design and diabetes interaction	Low–moderate, indirect
Cardiometabolic outcomes of omega-3 intake	1 observational CKD study	Generally favorable	Small sample and observational design	Low, indirect
TMAO after fish intake	1 small crossover trial, n = 14	No significant change	Very small sample and short duration	Low, indirect

4.1.6. Quantitative Meta-analysis

Meta-analysis of the outcome using a quantitative approach is not possible based on the identified studies at present time. Seven studies have been included in the evidence analysis, however, only one study by Lusviana and Astuti (2021) examined catfish intake and serum

albumin in patients with CKD or undergoing hemodialysis. All other studies analyzed different exposures and outcomes, including fish intake, fish oil, incidence of CKD, eGFR, cardiovascular markers, and TMAO. Therefore, combining these studies in a mean difference or standardized mean difference would be very heterogeneous in both clinical and methodology aspect and will not respond to the research question.

Table 4.7. Feasibility of Quantitative Pooling

Study	Catfish intervention	CKD population	Serum albumin outcome	Quantitative pooling
Lusviana & Astuti (2021)	✓	✓	✓	Potentially eligible, but insufficient numerical data
Mafra et al. (2023)	✗	✓	✗	Not eligible
Lu et al. (2023)	✗	✓/general population	✗	Not eligible
Liu et al. (2023)	✗	General population	✗	Not eligible
Ristic-Medic et al. (2024)	✗	✓	✗	Not eligible
Sadeghi et al. (2025)	✗	General population/prospective cohorts	✗	Not eligible for albumin outcome
Manhães et al. (2025)	Cod fish	✓	✗	Not eligible for albumin outcome

Thus, no pooled MD/SMD, I^2, Cochran's Q, funnel plot, or Egger's test should be reported for serum albumin based on these seven studies. Performing such analyses with the available evidence would constitute inappropriate statistical pooling. Because publication-bias tests such as Egger's regression generally require a substantially larger number of comparable studies, they are also not applicable to the present direct evidence base. In particular, the commonly used threshold of approximately 10 studies cannot be met for the specific catfish–serum albumin question.

4.2. Discussion

4.2.1. Potential Role of Catfish Protein in Improving Serum Albumin

This positive effect of catfish consumption on the concentration of serum albumin might be attributed mainly to the fact that catfish is relatively easily obtainable and represents a good source of animal protein. Patients with CKD, especially hemodialysis patients, have an increased risk of protein-energy malnutrition due to a lack of nutrients from dietary sources, inflammation, metabolic disorders, and losses of proteins during the procedure of dialysis. In such cases, the proper intake of proteins becomes essential in terms of nutritional status and production of circulating proteins in the liver.

Catfish provides essential amino acids which are necessary for building proteins and maintaining tissue function. The nutritional benefits of catfish may even lie in its availability and acceptance, especially in cases where catfish is cheaper compared to other animal protein sources. Therefore, nutrition programs using catfish would be practically applicable in developing countries where affordability of a certain food source is an issue.

However, the serum albumin level cannot be taken into account as a direct biomarker for adequacy of protein consumption alone. The reason is that serum albumin level depends on several factors such as inflammation, hydration, production by liver, excretion via urine or dialysis, and others. Hence, an increased level of albumin after taking catfish could indicate improvement in protein intake and other physiological aspects. There may have been fewer chances for clinical heterogeneity among the subjects studied by Lusviana and Astuti (2021) because of the exclusion criteria they applied such as patients with anasarca edema and malignancy.

These results thus lend credence to the hypothesis that protein-rich catfish may be effective in improving nutrition, although they do not provide evidence that there is something special about catfish in raising levels of albumin relative to other sources of high-quality protein. It will be important in future studies to compare catfish against a suitable protein control, in which measurements of total protein and energy intakes, inflammatory status, adequacy of dialysis, and fluid status are carefully controlled.

4.2.2. Comparison with Previous Evidence on Fish Consumption and CKD

The results obtained from the current literature review are largely compatible with the existing evidence indicating the possibility of beneficial nutritional effects of fish in relation to CKD. Mafra et al. (2023) highlighted fish as a food product rich in omega-3 polyunsaturated fats, amino acids, collagen, vitamins, and iodine. The above-mentioned components can be considered nutritional reasons why fish may be included in the proper dietary regime for CKD. Nonetheless, fish consumption is associated with metabolic effects as fish contain compounds involved in the TMAO production process.

Observational studies with large evidence base have also shown potential benefits of fish intake for kidney health. According to Liu et al. (2023), who used the dataset from 408,023 UK Biobank participants, the routine intake of fish oil was associated with reduced risk of CKD. The consumption of at least two weekly portions of oily or non-oily fish was also linked to the decreased risk of CKD. Likewise, Sadeghi et al. (2025) found pooled relative risk for CKD in fish eaters as 0.88 and suggested that each 15 g/day increment in dietary fish was related to the 6% decrease in CKD risk.

However, the results are not always positive. According to Lu et al. (2023), the connection between the intake of fish and seafood products and the functionality of kidneys varies depending on diabetes presence. For those who have normal glucose levels, there is a relationship between higher fish intake and reduced eGFR, while for people with diabetes, this relationship is not statistically significant. Thus, the impact of fish intake is highly dependent on the population's peculiarities..

It is noteworthy that all these studies were conducted on renal functions and/or CKD development but not on serum albumin. In other words, it is impossible to use them to prove the direct effect of fish intake on albumin. Instead, they give us background information on the plausibility of fish diet as a nutrition factor in CKD patients. This current review builds upon that literature in regard to catfish as protein and serum albumin as nutritional effect.

4.2.3. Cardiovascular and Metabolic Considerations

The possible nutritional advantages of eating catfish should be evaluated against the backdrop of the cardiovascular and metabolic condition of CKD. People suffering from CKD have an extremely high risk of developing cardiovascular diseases, and their diet quality may

impact various cardiovascular risk factors. The study by Ristic-Medic et al. (2024) involved 77 CKD patients who were either pre-dialysis or undergoing hemodialysis treatment. They found out that alpha-linolenic acid intake was negatively correlated with systolic blood pressure, carotid intima-media thickness, C-reactive protein levels, and intact parathyroid hormone. The findings of their study suggest that a diet of good fatty acids influences more than nutritional health.

Results obtained by Liu et al. (2023) are also consistent with the potential health benefits related to fish omega-3 fatty acids in terms of cardiovascular and kidney health. Indeed, the findings from the prospective cohort of Liu et al. (2023) revealed a significant inverse association between fish oil supplementation, intake of fish, and circulating omega-3 polyunsaturated fatty acids with developing CKD. However, these findings do not imply any effect on serum albumin levels.

However, when looking at fish consumption for CKD, we have to consider the TMAO metabolism. The study conducted by Mafra et al. (2023) pointed out the fact that TMAO should be considered since patients with CKD show decreased renal clearance and changes in gut microbiota. However, Manhães et al. (2025) provided some information that could reassure the use of fish in hemodialysis patients. It was found that eating cod for four days did not affect TMAO plasma concentration compared to red meat diet.

This means that there is no need to categorize fish consumption as good or bad in CKD because it may all depend on different factors like the type of fish, its preparation, amount, overall dietary intake, metabolic state and the patient himself. As far as the current research problem goes, the possible advantages of the consumption of fish can justify the choice of catfish as a protein resource; however, this does not mean that we will study the influence of catfish on serum albumin.

5. Conclusion

The findings of this systematic review suggest that catfish consumption, high in protein, could be beneficial for increasing albumin levels among patients with CKD, especially hemodialysis patients. Lusviana and Astuti (2021) provided the most powerful direct evidence showing significant increase in albumin levels after consuming catfish. Moreover, some

indirect evidence suggests the nutritional benefits of fish based on the associations with positive results for the kidney, cardiovascular system, and metabolism. Nevertheless, at the same time, the existing evidence is relatively limited, and it was impossible to conduct any quantitative meta-analysis for serum albumin due to the fact that there is only one study evaluating the impact of catfish consumption on the serum albumin level.

Further research will involve conducting well-designed randomized controlled trials using large sample sizes and standardized doses of catfish protein. The studies will include serum albumin levels and dietary protein intake in relation to inflammatory markers, nutritional status, and dialysis factors. Comparison between catfish and other protein sources and varied intervention periods and modes of preparation are essential. In the absence of compelling evidence, catfish can be viewed as a potential source of protein for CKD management.

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